UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF MINNESOTA

UNITED STATES OF AMERICA,

Plaintiff,

Case No. 18-cr-00194 (ADM/DTS)

vs.

KENNETH DAVON LEWIS,

Defendant.

**DEFENDANT'S OBJECTIONS TO JANUARY 6, 2020
REPORT AND RECOMMENDATION**
_____

Pursuant to Local Rule 72.2, defendant Kenneth Davon Lewis objects to the Magistrate Judge's January 6, 2020 Report and Recommendation recommending that the Court deny Defendant's Motion to Exclude Evidence (ECF No. 115.)

The government intends to offer DNA evidence generated by a forensic software program called STRMix at trial. This program uses a complex set of algorithms to interpret DNA mixtures and purports to be able to compare the probability that a defendant or other person of interest contributed DNA to a sample to the probability that an unknown individual contributed the DNA. This comparison is called a likelihood ratio ("LR"). Defendant has moved to exclude this evidence under *Daubert*. The Magistrate Judge recommends that the Court admit the evidence, and Defendant objects to that recommendation.

1

I.   FACTS AND PROCEDURAL POSTURE

There are three DNA samples at issue here. They were purportedly derived from swabs of the grip and trigger areas of the firearm allegedly possessed by Mr. Lewis (sample 8-A), the slide serrations, safety, slide release levers and hammer of the firearm (sample 8-B), and the baseplate and top edges of the magazine (sample 10-A). (*See* SMR 1; Gov. Ex. 19.)

The Midwest Regional Forensic Laboratory ("MRFL") interpreted sample 8-A as a mixture of four contributors. (*See id.*; SMR 17-20.)   Per STRMix, the major contributor provided 55% of the DNA in the sample. The lowest-level minor contributor provided 5% of the DNA. (*Id.*) STRMix calculated that the mixture in sample 8-A is greater than one billion times more likely if it originated from a mixture of DNA from Defendant and three unknown unrelated individuals than if it originated from four unknown unrelated individuals.

MRFL interpreted sample 8-B as a mixture of four contributors. Per STRMix, the major contributor provided 56% of the DNA. The lowest-level minor contributor provided 6% of the DNA. (*Id.*) STRMix calculated that the mixture in sample 8-B is greater than one billion times more likely if it originated from a mixture of DNA from Defendant and three unknown unrelated individuals than if it originated from four unknown unrelated individuals.

MRFL interpreted sample 10-A as a mixture of four contributors. Per STRMix, the major contributor provided 51% of the DNA in the sample. The lowest-level minor

contributor provided 2% of the DNA. (*Id.*) STRMix calculated that the mixture in

sample 10-A is greater than one billion times more likely if it originated from a mixture

of DNA from Defendant and three unknown unrelated individuals than if it originated

from four unknown unrelated individuals.

The government intends to introduce at trial evidence regarding the STRMix

likelihood ratios ("LRs") for samples 8-A, 8-B, and 10-A. Defendant filed a *Daubert*

motion to exclude this STRMix evidence on October 29, 2018. (ECF No. 27.) The Court

held three evidentiary hearings on this motion over the ensuing ten months, and ordered

that the parties file post-hearing briefs on the issues raised at the hearings. (*See*

Memoranda, ECF Nos. 107-110.) The Court also enlisted a Special Master to review the

evidence and comment on the issues regarding STRMix raised by Defendant. (*See*

Special Master Report ("SMR"), ECF No. 113.) The Magistrate Judge issued a Report

and Recommendation regarding Defendant's *Daubert* motion on January 6, 2020,

recommending that evidence regarding evidence as to Defendant's inclusion as a

potential contributor to the DNA mixtures at issue here, but also recommended that

evidence as to the exclusion of other individuals as contributors to the mixtures at issue

not be admitted. (Report & Recommendation ("R&R") at 63.)

II.   OBJECTIONS

The Magistrate Judge determined that, at least with respect to the evidence as to

Defendant's inclusion as a potential contributor to the DNA mixtures, STRMix is

sufficiently reliable to support admissibility under *Daubert*. (R&R 63.) Accordingly, the

Magistrate Judge recommended that this evidence be admitted. (*Id.*)   Defendant objects

to this recommendation.[1]

Under Rule 702 and *Daubert,* "the court serves as gatekeeper to ensure that a

witness is 'qualified as an expert by knowledge, skill, experience, training, or education,'

that the testimony is 'based upon sufficient facts or data, ... [and] is the product of reliable

principles and methods,' and that 'the witness [applies] the principles and methods

reliably to the facts of the case.'" *Shuck v. CNH Am., LLC*, 498 F.3d 868, 874 (8th Cir.

2007) (quoting Fed. R. Evid. 702). "The Supreme Court made clear in *Daubert* that no

purportedly scientific expert testimony could be admitted unless it met certain rigorous

requirements." *U.S. v. Glynn*, 578 F.Supp.2d 567, 570 (S.D.N.Y. 2008) (Rakoff, J.)

(citing *Daubert*, 509 U.S. at 593-94).

Factors relevant to a *Daubert* inquiry include (but are not limited to): "(1) whether

the theory or technique 'can be (and has been) tested'; (2) 'whether the theory or

technique has been subjected to peer review and publication'; (3) 'the known or potential

rate of error'; and (4) whether the theory has been generally accepted." *Peitzmeier v.*

Hennessy Indus., Inc., 97 F.3d 293, 297 (8th Cir. 1996) (quoting *Daubert,* 509 U.S. at

593, 594, 113 S.Ct. 2786).

"The proponent of the expert testimony bears the burden to prove its admissibility

by a preponderance of the evidence." *Kruszka v. Novartis Pharmaceuticals Corp.*, 28

F.Supp.3d 920, 926 (D. Minn. 2014); *see also Lauzon v. Senco Products, Inc.*, 270 F.3d

---

[1]   Defendant does not object to the Magistrate Judge's recommendation that
evidence as to the exclusion of other individuals from the mixtures at issue be excluded.
(*See id.*)

681, 686 (8th Cir. 2001).   Thus, it is the government's burden to prove by a preponderance of the evidence that the MRFL's use of STRMix is sufficiently reliable to be admissible here.

The Magistrate Judge's conclusion that STRMix meets *Daubert's* admissibility standard under the circumstances of this case is erroneous. Specifically, the Magistrate Judge erred in concluding that foundational validity questions surrounding STRMix have been addressed, that there is a knowable error rate for STRMix and that it is "small," and that STRMix's software development processes were sufficiently reliable and comported with industry standard practices.

A.   STRMix Has Not Demonstrated Foundational Validity.

In 2016, the President's Council of Advisors on Science and Technology ("PCAST") issued a report on the state of forensic science that addressed, among other things, the emerging technology of probabilistic genotyping programs like STRMix. (Def. Ex. 2.) It stated:

> These probabilistic genotyping software programs clearly represent a major improvement over purely subjective interpretation. However, they still require careful scrutiny to determine (1) whether the methods are scientifically valid, including defining the limitations on their reliability (that is, the circumstances in which they may yield unreliable results) and (2) whether the software correctly implements the methods. This is particularly important because the programs employ different mathematical algorithms and can yield different results for the same mixture profile.

(Def. Ex. 2 at 79.)

The PCAST Report went on to state that "validation of such programs should consist of studies by multiple groups, *not associated with the software developers*, that investigate the performance and define the limitations of programs by testing them on a wide range of mixtures with different properties."   (*Id.* (emphasis in original).) Importantly, PCAST found that validation studies on STRMix to that point had only established its reliability for "three-person mixtures in which the minor contributor constitutes at least 20 percent of the intact DNA in the mixture and in which the DNA amount exceeds the minimum level required for the method." (*Id*. at 82.)

In 2017, PCAST issued an Addendum to the Report, in which it reiterated its Report finding that:

> . . . empirical testing of PG had largely been limited to a narrow range of parameters (number and ratios of contributors). We judged that the available literature supported the validity and reliability of PG for samples with three contributors where the person of interest comprises at least 20% of the sample. Beyond this approximate range (i.e. with a larger number of contributors or where the person if interest makes a lower than 20% contribution to the sample), however, there has been little empirical validation.

(*See* PCAST Addendum, ECF No. 48-2.)

The samples here fall outside the bounds PCAST considered to be validated. As defense DNA expert Dr. Daniel Krane explained: "We're talking here about a mixture of at least four contributors, if not at least five, where there are clear indications of allelic drop-out and where STRMix itself seems to have ascertained or surmised that the lowest level contributors were contributing less than 10 percent to the overall amount of template DNA in the sample." (Hr'g Tr. III, 430:16-25.)

The Magistrate Judge concluded, however, that a 2017 STRMix validation study conducted in the wake of the PCAST Report ("the PCAST Response") had addressed these validity concerns. (*See* R&R 28-32.)   But the PCAST Response tested a different and version of the software that was more advanced and materially different than the one used here.   The MRFL processed the DNA mixture data in this case using STRMix Version 2.4.05.   The PCAST Response tested STRMix Version 2.5.02.   Numerous changes were made to STRMix between v.2.4.05 and v.2.5.02 that directly affect the LR calculations performed by the different versions, changes above and beyond those discussed in the R&R.   The Magistrate Judge identified Defendant's concern with this purported "retroactive validation" as a "fair . . . but unpersuasive" criticism. (R&R 3.) In addressing this concern, however, the Magistrate Judge failed to address several apparently significant differences between the two software versions.

First, changes that affected the manner in which the LR was calculated were made to v2.4.05 that resulted in issuance of v2.4.06. Specifically, changes were made to the calculation of the probability of a forensic phenomenon known as allelic drop-in. (*See* STRMix v2.04.06 Release and Testing Report 2017, Def. Ex. 24.)   The Magistrate Judge concluded this change did not have a material impact on the STRMix output, and thus the two STRMix versions at issue were not materially different. (*See* R&R 33-34.)

But other changes were made between v.2.4.05 and v.2.4.08 that also affected the program's output but were not addressed in the R&R. Changes were made to the LR calculation process which resulted in the issuance of v2.4.08. (*See* "Description of the likelihood ratio (LR) changes in STRMix v2.4.08," Def. Ex. 24.) These changes related

in part to the order of contributors within the LR calculation. (*See id.* at 1.) Per ESR's

notification of the changes to its STRMix customers, 40 of the 85 mixtures tested resulted

in different LRs when the new calculation process was used. (*Id.*)

In addition, government expert and STRMix creator Dr. John Buckleton testified

that an algorithm related to drop-in probabilities was changed between versions which

per Dr. Buckleton testified would lead to a change in LRs. (Hr'g Tr. III, 475:15-476:9;

498:23-499:14.)   Similarly, the method for calculating FST value – a critical LR

calculation component – changed between versions because it was "ugly and error

prone." (Def. Ex. 29, Tab 26 at 4; Hr'g Tr. III, 476:10-477:12; 503:10-504:5.) All these

changes would have individually affected the LR outputs of the software per Dr.

Buckleton's own testimony.   Collectively, their combined effect on LRs is unknown.

There is no evidence that ESR ever assessed the difference between LR's created by

v.2.4.05 and v.2.5.02. Because the versions were materially different according to the

testimony of the government's own expert witness, validation testing of the later version

cannot be said to have retroactively validated the earlier version, and for this reason the

Magistrate Judge erred when concluding the PCAST response study sufficiently validated

the STRMix version used in this case.

B.   STRMix Has No Known Error Rate.

As ESR explains in the STRMix User's Manual, STRMix at least arguably has an

unknowable error rate: "No 'true' LR is available, and many would argue no such thing

exists. It is therefore not possible to examine the results against some true answer . . . ."

(Def. Ex. 24, STRMix v2.4 User's Manual at 112.) The Magistrate Judge concluded

nonetheless: "the absence of a *precisely calculated* error rate (because there is no ground truth LR) is not the same as saying there is no *known* error rate. The error rate for false inclusion is known and is acceptably small." (R&R 42.)

First, at no point during the three days of evidentiary hearings, or any of the thousands of pages of documents, including scientific articles, has anyone identified even a range of potential error rates with respect to false inclusion. Dr. Buckleton testified that the error rate with respect to false inclusions was "immeasurably small." (*See* Hr'g Tr. I at 64.) The Magistrate Judge notes that the rate of false inclusions demonstrated in the STRMix PCAST response study was shown to be "acceptably small." (R&R 42.) Similarly, the Special Master stated, "while there were a few instances in which STRMix produced results that falsely linked non-contributors to the mixtures, these misleading results were rare . . . ." (SMR 8.) Again, however, despite these claims that the error rate is "small" or "rare," no numerical error rate or range of error rates for STRMix false inclusions has ever been stated on the record, in the documentary evidence filed here, or apparently anywhere else.

More critically, the Magistrate Judge appears to conflate the error rate for inclusion (any LR greater than 0 for a defendant) with the rate at which STRMix generates inaccurate likelihood ratios. For example, STRMix might calculate the probability that a defendant's DNA profile is found in a mixture as 1 billion times more likely than if the defendant's DNA profile is not in the mixture. If, in actuality, it is only 20 times more likely (and not 1 billion times more likely) that the defendant's DNA profile is found in the mixture, that would be a material error by STRMix, and one which

could easily affect the outcome of a case.   This mistake would not be considered a false

inclusion, but it would be a material error nonetheless. Yet there are no published studies

regarding STRMix's error rate with respect to inaccurate likelihood ratios.

The one scientific publication identified during the hearing that addressed this

issue stated that more research is still needed to assess how often STRMix gets the

numbers (as opposed to "inclusion") wrong:

> A true blinded inter-laboratory validation comparing
> [likelihood ratio] values obtained for common, independently
> generated DNA mixtures in equal proportions from N donors
> (N>2) is required to truly assess the accuracy, precision, and
> reproducibility of STRMix.

(Def. Ex. 26 at 1-2.)   Because no such validation study has yet been published, and

because STRMix's error rate is at this point unknown, the Magistrate Judge erred in

concluding this *Daubert* factor weighs in favor of admissibility. *See, e.g., United States*

v. Crisp, 324 F.3d 261, 273-274 (4th Cir. 2003) (concluding government had "utterly

failed" to meet its burden under *Daubert* and stating that "an error rate must be

demonstrated by reliable scientific studies" which had not been presented by the

government); *United States v. Green*, 405 F. Supp. 2d 104, 119 (D. Mass. 2005) ("Expert

evidence should not be excluded merely because witnesses practicing in that field make

errors with some frequency, but also because the factfinder has no information about the

likelihood of error in the opinions, and thus cannot adjust the weight to be given to the

evidence.") (internal citation omitted).

C.   STRMix Did Not Follow Minimum Software Industry Practices To Ensure Its Software Performed Reliably.

Defendant put on substantial expert testimony during the evidentiary hearing related to issues of software testing verification and validation. Specifically, Defendant presented testimony regarding the need for robust software testing when the use of the software at issue may impact someone's liberty or life. The Magistrate Judge concluded that the STRMix software development process was sufficiently robust as to ensure its reliability. In reaching this conclusion, the Magistrate Judge focused on the Institute of Electrical and Electronics Engineers ("IEEE") software development standards. (*See* R&R 36-38.) Specifically, the Magistrate Judge concluded that even if STRMix did not meet the IEEE standards, it came close, and thus has demonstrated sufficient reliability as a software program. (*Id.*) This conclusion does not address significant testimony by defense expert Dr. Mats Heimdahl, Dean of the University of Minnesota Computer Science and Engineering Department and expert in the fields of software development and testing.

Dr. Heimdahl testified that regardless of STRMix's compliance or non-compliance with IEEE standards, in his opinion, the development of STRMix did not satisfy general standard industry practices for the development and testing of new software. (*See* Hr'g Tr. III 580:1-581:9 ("…[IEEE is] not the end-all/be-all standard . . . there are, of course, best practices that may or may not be included there").)

Per Dr. Heimdahl, STRMix development has fallen grievously short of the minimum industry requirements for software that is life or freedom critical. (Hr'g Tr. III

575:17-577:13; 581:14-22; 588:7-19.)   Ultimately, he testified that while it appears ESR

is on the right track going forward with respect to software development practices,

STRMix to date is not sufficiently validated from a software engineering perspective:

> In my opinion, it's not adequately validated. . . . If we can
> assume that all the math and the heuristics and the modeling
> is correct [in STRMix], we still have to build software that
> does that correctly . . . it seems to be a plethora of
> configuration parameters that may or may not have been
> explored effectively during the validation testing efforts, but
> this is where the verification testing would come in and start
> twiddling all of those in all kinds of different ways to see if
> they interact in unexpected ways, if it always works and if it
> fails when it's expected to fail, and so on and so forth.

(Hr'g Tr. III, 590:15-591:12.)   The Magistrate Judge erred in not crediting this critical

expert testimony from the highly-qualified Dr. Heimdahl.

III.   CONCLUSION

For the above-stated reasons, the Defendant respectfully requests that the Court

decline to adopt the Magistrate Judge's recommendation that STRMix evidence as to

Defendant's inclusion as a potential contributor to the DNA mixtures in this case be

admitted, and instead exclude that evidence.

Respectfully Submitted,

Dated: January 21, 2020.

/s/ Kevin C. Riach
Kevin C. Riach (#0389277)
FREDRIKSON & BYRON, P.A.
200 South Sixth Street, Suite 4000
Minneapolis, MN 55402
(612) 492-7435
(612) 492-7077 (fax)
kriach@fredlaw.com